REMARKS

Applicant has studied the Office Action dated April 11, 2003 and has made amendments to the claims. Applicant respectfully requests entry of this amendment under the provisions of 37 C.F.R. § 1.116(a) in that the amendment and remarks below place the application and claims in condition for allowance. It is submitted that the application, as amended, is in condition for allowance. Claims 2-25 are pending. Claim 16 has been amended. Reconsideration and allowance of the pending claims in view of the above amendments and the following remarks are respectfully requested.

As an initial matter, Applicant submits that the claim amendments made herein do not raise new issues in the application. Independent claim 16 has been amended to include a limitation that was in claim 5 as originally filed and that was previously added to independent claims 8, 14, and 20. Thus, this change does not raise new issues in the application. Applicant respectfully submits that the present amendment places the application in condition for allowance or, at least, presents the application in better form for appeal. Entry of the present amendment is therefore respectfully requested.

Claims 3, 5, 6, 8, 10, 12, 14, 16, 18, 20, 22, and 24 were rejected under 35 U.S.C. § 102(e) as being anticipated by Lin (U.S. Patent No. 6,044,178). Claims 7, 9, 13, 15, 19, 21, and 25 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Lin in view of Miyake (U.S. Patent No. 6,088,489). These rejections are respectfully traversed.

The present invention is directed to methods and devices for scaling an image from one resolution to another in which the convolution kernel to be applied is selected based on local image content. One preferred embodiment of the present invention provides a method for scaling a source image to produce a scaled destination image. According to the method, a local context metric is calculated from a local portion of the source image, and a convolution kernel is generated from a plurality of available convolution kernels based on the calculated local context

metric. The generated convolution kernel is used to generate at least one pixel of the scaled destination image, which has a different resolution than the source image. The available convolution kernels include at least one smoothing kernel and at least one sharpening kernel. Because the pixels of the scaled image are generated by selectively sharpening or smoothing the source image depending on the calculated local context metric, the scaling process generates a high quality scaled image.

The Lin reference discloses an image processing apparatus and method for translating a source image to a display image having lower resolution. However, Lin does not disclose a method for scaling a source image to produce a scaled destination image in which a convolution kernel is generated from a plurality of available convolution kernels based on a calculated local context metric, and the generated convolution kernel is used to generate at least one pixel of the scaled destination image, with the available convolution kernels including at least one smoothing kernel and at least one sharpening kernel, as is recited in claim 5. Claim 8 contains similar recitations.

Similarly, Lin does not disclose an image scaling device for receiving pixels of a source image and outputting pixels of a scaled destination image that includes a kernel generator for generating a current convolution kernel from a plurality of available convolution kernels based on a local context metric calculated by a context sensor, and a scaler for using coefficients of the current convolution kernel to generate at least one pixel of the scaled destination image, with the available convolution kernels including at least one smoothing kernel and at least one sharpening kernel, as is recited in claim 14. Claims 16 and 20 contain similar recitations.

The image processing system of Lin first separates a source image into a black text image portion, a white text image portion, and a background image portion. This separation of the source image S is performed by the combination of a thresholding unit 52, a text masking unit 54, a text segmentation unit 58, and an image separation unit 66, as shown in Figure 2. The three separated image portions are then separately processed by a down-sampling unit 70 in order to produce corresponding portions of the down-sampled (or scaled) image, as shown in Figure 3. More specifically, the down-sampling unit 70 includes three separate low pass filter units 78, 86, and 72 for separately down-sampling (scaling) the black text, white text, and background image

portions of the source image. The down-sampled (scaled) image portions are further processed, and then an image merging unit 96 merges the three down-sampled (scaled) image portions to produce the complete down-sampled (scaled) image.

In the image processing system disclosed in Lin, the down-sampling unit 70 scales the different portions of the source image using different low pass filter units 78, 86, and 72. However, <u>all</u> of the low pass filter units use <u>a gaussian smoothing convolution kernel</u> to scale their respective image portions. In particular, low pass filter unit 72 uses "a gaussian filter" to scale the background image portion, low pass filter unit 78 uses "a gaussian filter" to scale the black text image portion, and low pass filter unit 78 uses "a gaussian filter" to scale the white text image portion. <u>See</u> Lin at 6:18-19, 6:33-34, 6:55-56. Lin further discloses that low pass filters unit 72 implements a gaussian filter with kernel coefficients of: "1/10, 1/5, 2/5, 1/5, 1/10", and that low pass filter units 78 and 86 each implement a gaussian filter with kernel coefficients of: "1/15, 3/15, 7/15, 3/15, 1/15". <u>See</u> Lin at 6:19-22, 6:34-37, 6:56-58.

The Examiner has taken the position that the filters and convolution kernel coefficients disclosed in Lin represent a smoothing convolution kernel and a sharpening convolution kernel. This position of the Examiner is respectfully traversed. The terms "smoothing function" and "sharpening function" have specific meanings in both Applicant's specification and the art of image processing. A <u>"smoothing function"</u> and its corresponding <u>"smoothing convolution kernel"</u> function to smooth or blur an image by removing detail and noise. On the other hand, a <u>"sharpening function"</u> and its corresponding <u>"sharpening convolution kernel"</u> function to sharpen an image by highlighting edges and adding contrast, but also increases noise. Thus, the effect is completely different when a smoothing convolution kernel and a sharpening convolution kernel are applied to the same image.

The "gaussian" filters used in the image processing system of Lin are "smoothing" filters that each implement a "smoothing function". In particular, a "gaussian" filter performs "gaussian smoothing" using a convolution kernel that represents the shape of a gaussian function (i.e., a bell-curve). The gaussian function includes a variable (i.e., the standard deviation) whose value controls the shape of the function (i.e., the height and width of the bell-curve). Thus, the value chosen for this variable determines the degree to which the image will be smoothed (by defining

specific values in the corresponding gaussian smoothing convolution kernel). Similarly, a "sharpening function" such as the cubic function generally includes a variable that controls the shape of the function, and thus the degree to which the image will be sharpened.

Thus, two convolution kernels can have differing coefficients that operate to smooth or sharpen an image to different degrees. However, both kernels are "smoothing kernels" if each kernel operates to smooth the image, and conversely both kernels are "sharpening kernels" if each kernel operates to sharpen the image. In other words, regardless of the exact values of the coefficients, a convolution kernel is a "smoothing kernel" if its coefficients are derived from a smoothing function and operate to smooth or blur an image (e.g., by removing detail and noise), while a convolution kernel is a "sharpening kernel" if its coefficients are derived from a sharpening function and operate to sharpen an image (e.g., by highlighting edges, adding contrast, and increasing noise).

Lin does teach scaling the background portion of an image using kernel coefficients that are different than the kernel coefficients used to scale the text portions of the image. However, both of the convolution kernels used by Lin have coefficients derived from a gaussian smoothing function and will operate to smooth or blur the image portion to which they are applied. In particular, Lin discloses scaling the background portion using kernel coefficients of: "1/10, 1/5, 2/5, 1/5, 1/10", and scaling the text portions using kernel coefficients of: "1/15, 3/15, 7/15, 3/15, 1/15". Each of these sets of coefficients does represent a function having a different shape, but each is also clearly representative of a smoothing function and will operate to smooth the image portion to which it is applied to some degree. As explained above, "smoothing" and "sharpening" are well defined image effects with specific meanings in both Applicant's specification and the art of image processing. A "smoothing convolution kernel" produces a smoothed image and a "sharpening convolution kernel" produces a sharpened image. It is improper to define two convolution kernels that both smooth an image but to different degrees as being a "smoothing kernel" and a "sharpening kernel". Thus, Lin only discloses using different "smoothing convolution kernels" to smooth different portions of an image to different degrees, and does not teach or suggest using a smoothing kernel and a sharpening kernel on different portions of an image.

In contrast, in the embodiments of the present invention recited in claims 5, 8, 14, 16, and 20, at least one smoothing kernel and at least one sharpening kernel are used in producing a scaled image. More specifically, a local context metric is calculated from a local portion of a source image. A convolution kernel is generated from a plurality of available convolution kernels based on the local context metric, with the available convolution kernels including at least one smoothing kernel and at least one sharpening kernel. The generated convolution kernel is used to generate at least one pixel of the scaled destination image. Thus, the image is scaled using convolution kernels generated from a plurality of available convolution kernels that include at least one smoothing kernel and at least one sharpening kernel.

Lin does not teach or suggest a method or device for scaling a source image to produce a scaled destination image in which a convolution kernel is generated from a plurality of available convolution kernels based on the local context metric, with the available convolution kernels including at least one smoothing kernel and at least one sharpening kernel. Applicant believes that the differences between Lin and the present invention are clear in claims 5, 8, 14, 16, and 20, which set forth various embodiments of the present invention. Therefore, claims 5, 8, 14, 16, and 20 distinguish over the Lin reference, and the rejection of these claims under 35 U.S.C.§ 102(e) should be withdrawn.

As discussed above, claims 5, 8, 14, and 20 distinguish over the Lin reference. Furthermore, the claimed features of the present invention are not realized even if the teachings of the Miyake reference are incorporated into Lin. Miyake does not teach or suggest the claimed features of the present invention that are absent from Lin. Thus, claims 5, 8, 14, and 20 distinguish over the Lin and Miyake references, and thus, claims 3, 6, and 7, claims 9, 10, 12, and 13, claims 15, 18, 19, and claims 21, 22, 24, and 25 (which depend from claims 5, 8, 14, and 20, respectively) also distinguish over the Lin and Miyake references. Therefore, it is respectfully submitted that the rejections of claims 3, 5-10, 12-15, 18-22, 24, and 25 under 35 U.S.C. § 102(e) and 35 U.S.C. § 103(a) should be withdrawn.

Applicant thanks the Examiner for indicating that claims 2 and 4 are allowable over the art of record, and that claims 11, 17, and 23 would be allowable if rewritten to include all of the limitations of the base claim and any intervening claims. Claims 11, 17, and 23 respectfully depend from claims 8, 14, and 20, which Applicant submits are allowable over the art of record. Accordingly, it is respectfully submitted that claims 2, 4, 11, 17, and 23 are in condition for allowance.

In view of the foregoing, it is respectfully submitted that the application and the claims are in condition for allowance. Reexamination and reconsideration of the application, as amended, are requested.

If for any reason the Examiner finds the application other than in condition for allowance, the Examiner is invited to call the undersigned attorney at (561) 989-9811 should the Examiner believe a telephone interview would advance the prosecution of the application.

Respectfully submitted,

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By: ______

Stephen Bongini
Registration No. 40,917
Attorney for Applicant

FLEIT, KAIN, GIBBONS,
GUTMAN & BONGINI P.L.
One Boca Commerce Center
551 Northwest 77th Street, Suite 111
Boca Raton, Florida 33487
Telephone: (561) 989-9811
Facsimile: (561) 989-9812